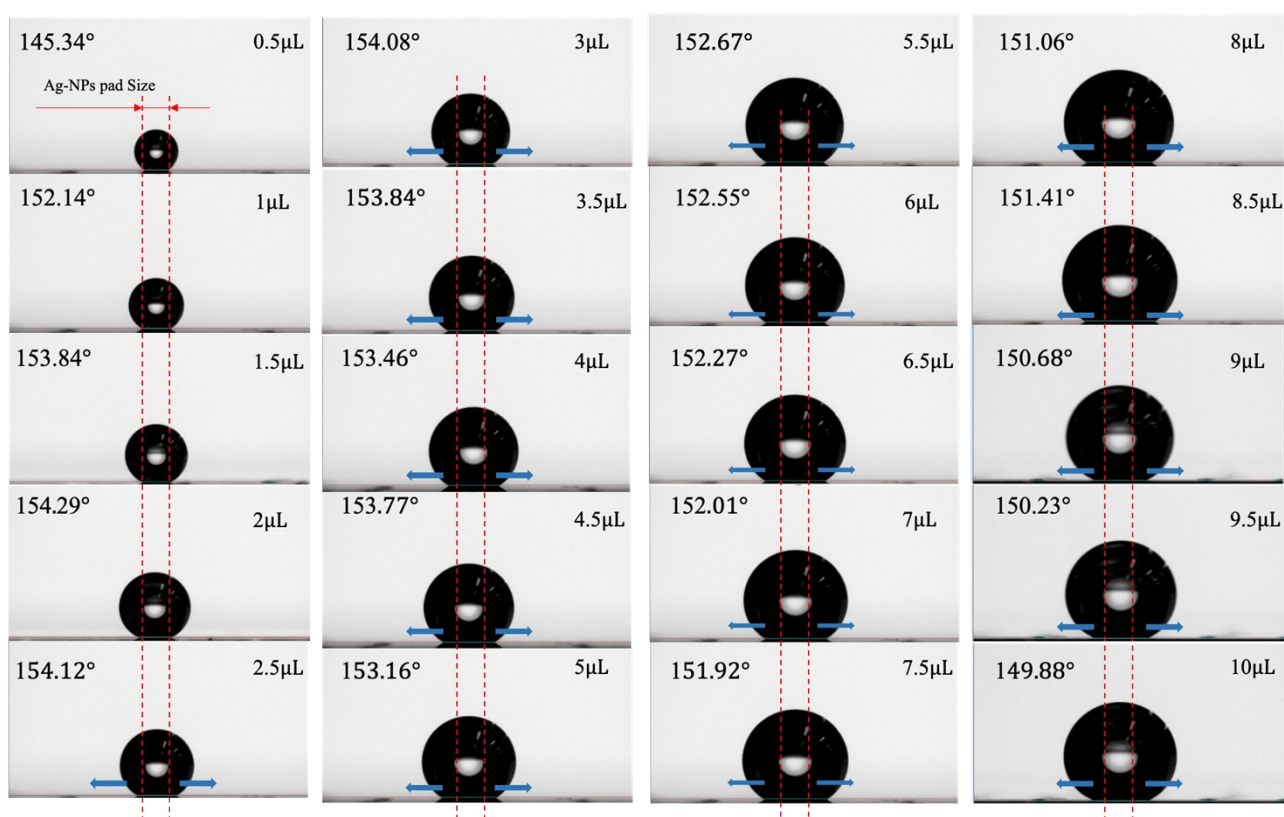


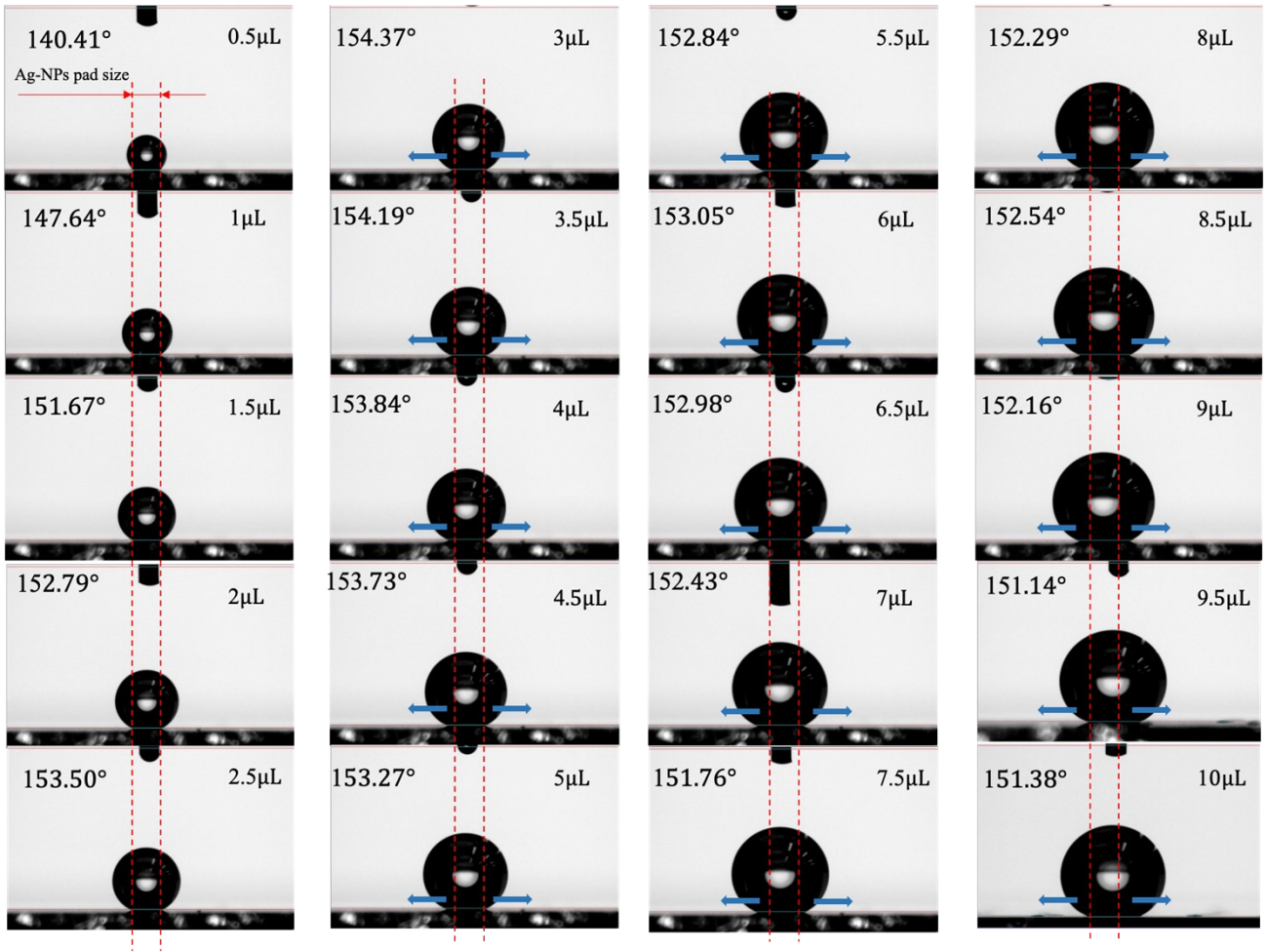
Supplementary Information

Utilization of microdroplet as optical lens for Surface-Enhanced Raman Spectrometry (SERS) enhancement on localized silver nanoparticle-decorated porous silicon substrate

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(a)



(b)

Figure S1. Images of contact angle for different microdroplet volumes with different (a) 1 μL and (b) 2 μL Ag-Drop deposition volume for 20 mM concentrations. The red-dash line indicate the Ag-NP pad size and the blue arrow indicates the droplet is spreading out of the Ag-NP pad.

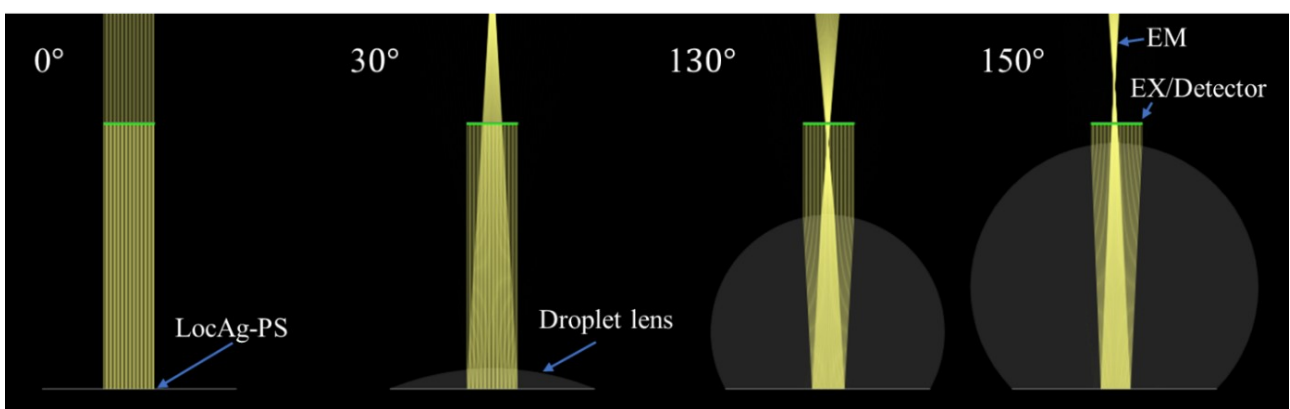


Figure S2. Optical simulation by PhyDemo was used to simulate the focusing effect of microdroplet lens for 0° , 30° , 130° , and 150° contact angle microdroplet lens.

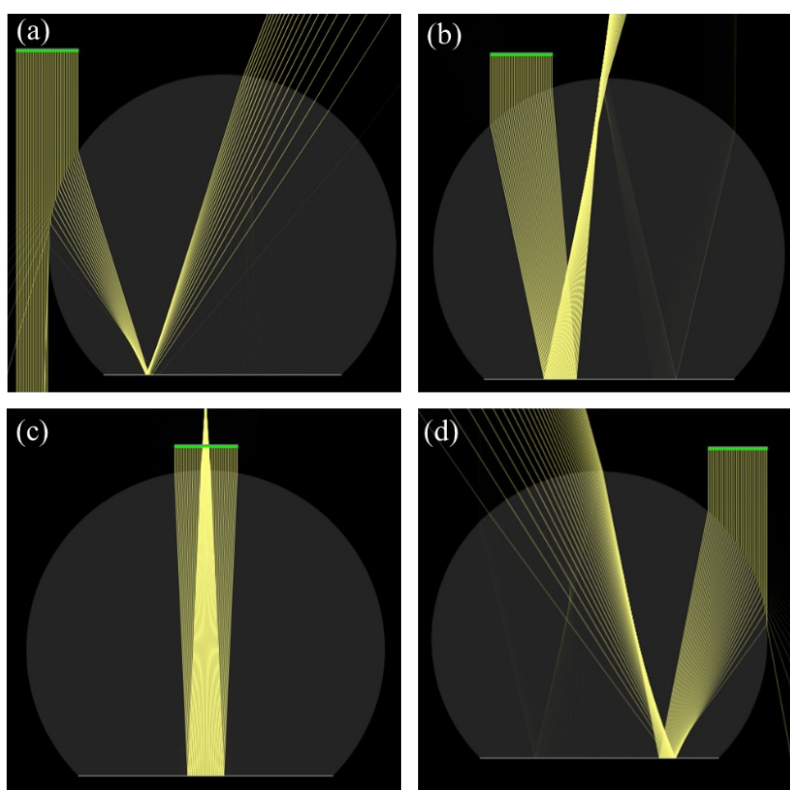


Figure S3. Optical simulation by PhyDemo was used to simulate the laser irradiation location for (a) Case I: On droplet edge (b) Case II: Inside the Ag-grated pad (c) Case III: center, and (d) Case IV: Out of grafted pads

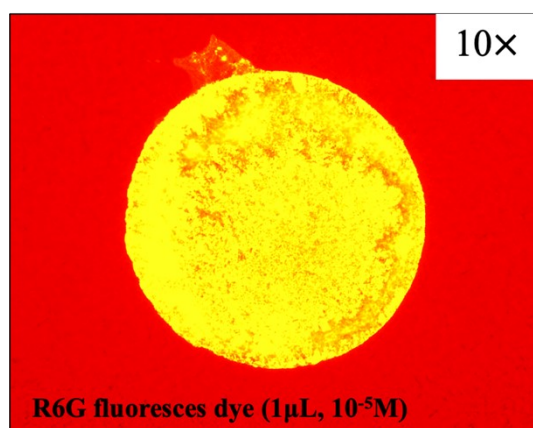


Figure S4. Fluorescent microscope image of a 1 μL drop of R6G fluorescent dye (10^{-5} M) deposited on a LocAg-PS surface. After drying for 2 minutes, the dye exhibits a good distribution across the surface with no visible signs of the coffee ring effect or other deposition inhomogeneities.

• Sample molecules



LocAg-PS surface

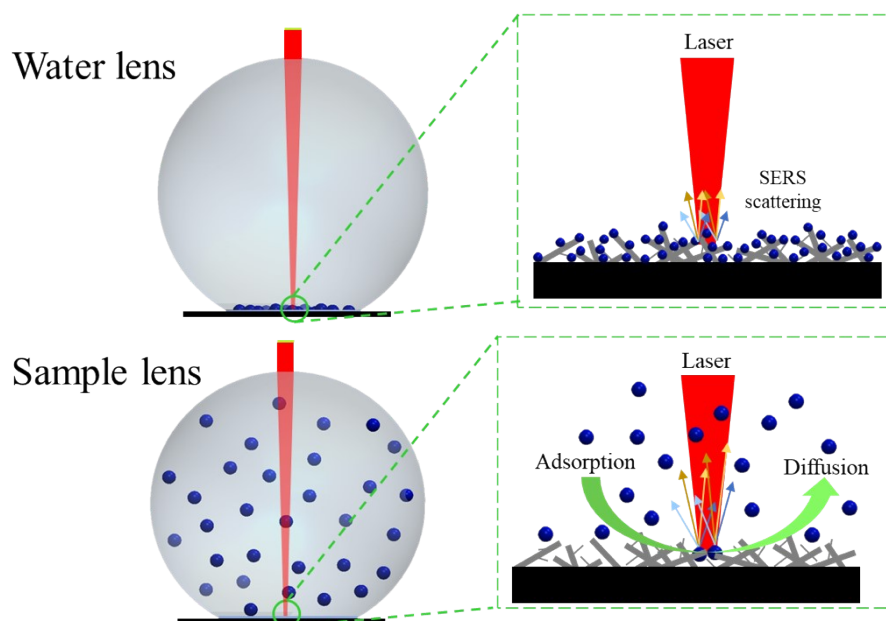


Figure S5. Schematic illustration of the microdroplet lens methods for SERS analysis on a LocAg-PS substrate. The top image illustrates the water droplet lens method, where the sample molecules are fixed at specific locations after drying on the substrate. The bottom image depicts the sample droplet lens method, where the sample molecules remain freely diffused within the droplet, leading to a more efficient interaction with the silver nanoparticles.

Table S1. Ag-NPs pad size with various Ag-Drop volume.

12mM	Ag-Drop Volume			
	1 μ L	2 μ L	5 μ L	10 μ L
First device	198.06 μ m	244.53 μ m	326.37 μ m	1255.20 μ m
Second device	194.81 μ m	223.28 μ m	338.62 μ m	1078.17 μ m
Third device	205.26 μ m	213.34 μ m	308.43 μ m	1101.18 μ m
Fourth device	198.66 μ m	236.11 μ m	357.15 μ m	1197.62 μ m

16mM	Ag-Drop Volume			
	1 μ L	2 μ L	5 μ L	10 μ L
First device	277.66 μ m	294.07 μ m	423.47 μ m	858.46 μ m
Second device	210.8 μ m	261.81 μ m	295.33 μ m	775.73 μ m
Third device	231.70 μ m	276.78 μ m	326.53 μ m	962.63 μ m
Fourth device	214.81 μ m	271.84 μ m	389.67 μ m	1121.46 μ m

20mM	Ag-Drop Volume			
	1 μ L	2 μ L	5 μ L	10 μ L
First device	224.23 μ m	320.63 μ m	354.33 μ m	1092.40 μ m
Second device	247.37 μ m	307.84 μ m	347.15 μ m	989.83 μ m
Third device	229.84 μ m	308.43 μ m	415.16 μ m	1187.38 μ m
Fourth device	252.51 μ m	311.49 μ m	392.56 μ m	879.79 μ m

Table S2. Contact angle change for water evaporation (water) under laser irradiation and room environment.

	Laser irradiation time							
	0min.	1min.	2min.	3min.	5min.	10min.	15min.	20min.
First time	150.26°	147.90°	140.17°	122.67°	105.29°	28.69°	0°	0°
Second time	152.17°	149.59°	138.45°	126.99°	107.37°	25.55°	0°	0°
Third time	157.53°	145.77°	125.99°	114.09°	84.07°	11.07°	0°	0°
Average value	153.32°	147.75°	134.87°	121.25°	98.91°	21.77°	0°	0°
Error bar	3.53°	1.91°	7.09°	6.45°	11.65°	8.81°	0°	0°

	Room environment evaporation							
	0min.	1min.	2min.	3min.	5min.	10min.	15min.	20min.
First time	154.33°	153.17°	147.56°	140.96°	134.90°	98.10°	12.75°	0°
Second time	152.21°	148.92°	140.46°	131.02°	112.44°	104.95°	20.88°	0°
Third time	155.19°	152.50°	146.92°	134.08°	117.88°	76.28°	20.01°	0°
Average value	153.91°	151.53°	144.98°	135.35°	121.74°	93.11°	17.88°	0°
Error bar	1.49°	2.12°	3.55°	4.97°	11.23°	14.34°	4.01°	0°

Movie S1: The full procedure of SERS analysis by microdroplet lens (sample) is available in Supporting information movie S1. The file is upload in supporting information

